

Vegetation Management Specialist Report

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Trout-West Historic and Current Condition

The Ponderosa Pine Cover Type, which dominates the Trout-West analysis area, is frequently characterized as “open-park like stands” of large trees, molded by frequent low intensity fire and a distinct absence of crown fire.

However, work by Kaufmann and others (Kaufmann et al. 2001; Kaufmann et al. 2000; Kaufmann et al. 1999; and Brown et al. 1999) indicates that the ponderosa pine/Douglas-fir type of central Colorado evolved under a different fire regime, resulting in a more complex, heterogeneous forest structure.

Kaufmann’s research provides a description of a ponderosa pine landscape that evolved from a mixed severity fire regime. Mixed severity fires differ from the frequent low intensity surface fire regime of the Southwest in that individual fire events generally are less frequent and have a patchy crown fire component along with surface fire. They differ from crown fire regimes because the crown fire component is smaller and much more patchy. In addition, tree recruitment occurred in pulses, each about 10 years long, with recruitment pulses tending to coincide with larger fires. (Kaufmann et al. 2001.)

This fire regime resulted in four basic stand conditions based on stand development stages and successional trajectories. The conditions are (1) openings vegetated primarily with grasses and shrubs, (2) patches that are pure or nearly pure ponderosa pine, (3) patches having both ponderosa pine and Douglas-fir, and (4) patches having very old trees or “persistent old growth.” The pine and pine/Douglas-fir patches have a specific characteristic distinguishing them from persistent old growth: a cap or upper limit on the age of the oldest trees in the patch. This suggests that they developed following a stand-replacing natural disturbance, most likely fire. In contrast, the persistent old-growth patches appear to be regulated primarily by microscale disturbances that kill only one or a few trees at a time, such as heartrot, insect attack, windthrow, or very small fires. Trees in these patches have a wide age distribution with varying states of health, and a large amount of coarse woody debris is common. Pure ponderosa pine stands developed on most east, south, and west facing slopes. In contrast, mixtures of ponderosa and Douglas-fir trees often were recruited on north slopes (Kaufmann et al. 2001). This information is summarized in Table 1, below:

Table 1. Stand Characteristics			
Stand Type	Crown Closure	Condition	Tree Age Structure
Openings	≤10 percent	May be mixed species	Few, generally young.
Ponderosa pine	>10 percent	≤ 10 percent BA Douglas-fir ≤ 20 percent of trees Douglas-fir	Age cap evident May be old growth
Ponderosa pine/ Douglas-fir	>10 percent	>10 percent BA Douglas-fir or >20 percent of trees Douglas-fir	Age cap evident May be old growth
Persistent old growth	>10 percent	Mixed ponderosa pine and Douglas-fir	No age cap evident Very old

Kaufmann's research also indicates that over 90 percent of the landscape had crown closures of 30% or less (Kaufmann et al. 2001).

Kaufmann also illustrated this information in Table 2, below:

Table 2. Percent and Range of Landbase in Various Components		
<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	20(15-30)%**	10(5-20%)
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	10(5-20)%	5(0-10)%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	15(10-25)%	25(15-35)%
40-70% crown closure	4(0-8)%	4(0-8)%
>70% crown closure	1(0-1)%	1(0-2)%
Mature (8-18" dbh)		
10-40% crown closure	30(20-40)%	35(25-45)%
40-70% crown closure	4(0-8)%	4(0-8)%
>70% crown closure	1(0-1)%	1(0-2)%
Decadent *	15(10-20)%	15(10-20)%
*Decadent refers to stands breaking apart because of microsite disturbances such as heartrot, windthrow, insect mortality, etc. (This would be the persistent old growth)		
**According to Kaufmann, this structural stage does not include meadows.		

The environment described by Kaufmann was not static, however; canopy cover was always on the increase, Douglas-fir was constantly attempting to establish itself on non-northerly aspects, pulses of pine regeneration periodically occurred, and openings were regenerated. However, fire would reduce the canopy, consume the Douglas-fir regeneration on non-northerly slopes, thin or consume the pine regeneration and pine/Douglas-fir regeneration on north slopes and create new openings or maintain old ones. Canopy cover was lowest immediately after a fire and highest just prior to a fire. Therefore, over space and time canopy cover would range widely, rarely exceeding 30%, but greater than 10% except in openings.

This scenario did not occur in concert across the landscape, but occurred at the stand or patch (sub stand) level. The size and degree of canopy reduction was all determined by the size and intensity of the previous fire.

The current Trout-West vegetative condition is dramatically different than the historic condition described above by Kaufmann. The two factors that have had the greatest influence on stand development and structure in the last century have been logging and fire suppression.

Logging in the late 19th and early 20th centuries removed virtually the entire overstory; as a result, the persistent old growth and older trees that Kaufmann referred to no longer exist or only insignificantly contribute to the landscape. Fire suppression resulted in the survival and growth of virtually all conifer regeneration, and the persistent openings described by Kaufmann have regenerated and few if any new ones have been created. At higher elevations, aspen would have dominated these openings, but fire suppression has allowed conifers to overtop and shade out the aspen.

The resulting landscape is now much denser than historically, Douglas-fir has encroached on non-northerly aspects, and openings have filled in. Stands have become multi-storied. Individual tree growth has stagnated, limiting the forest's ability to produce larger diameter trees. The landscape's forest structure is now simplified and homogenous compared to the historic complex and heterogeneous forest structure described by Kaufmann.

The following tables (Tables 3 – 9) represent the current stand structure within the Trout-West analysis area, by treatment unit. The tables are based on information collected in the summer and fall of 2001.

Table 3. Long John Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	2%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	14%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	20%	0%
40-70% crown closure	43%	100%
>70% crown closure	21%	0%
Decadent	0%	0%

Table 4. Phantom Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	0%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	1%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	41%*	0%
40-70% crown closure	47%	87%
>70% crown closure	11%	13%
Decadent	0%	0%

*The majority of these stands have canopy covers of 30-40%

Table 5 Rampart Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	0%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	0%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	50%*	0%
40-70% crown closure	36%	77%
>70% crown closure	14%	23%
Decadent	0%	0%

*The majority of these stands have canopy covers of 30-40%

Table 6. Ridgewood Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	4%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	1%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	48%	0%
40-70% crown closure	47%	98%
>70% crown closure	0%	2%
Decadent	0%	0%

Table 7. Ryan Quinlan Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	0%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	5%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	31%	0%
40-70% crown closure	57%	66%
>70% crown closure	7%	34%
Decadent	0%	0%

Table 8. Skelton Treatment Unit

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	0%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	0%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	3%	0%
40-70% crown closure	78%	54%
>70% crown closure	19%	46%
Decadent	0%	0%

Table 9. Total for All Treatment Units

Percent and range of landscape in various components:

<u>Structural Stage</u>	<u>Ponderosa Pine (south, east, west slopes)</u>	<u>Pond. Pine/Doug-fir (north slopes)</u>
Grass/forb	0%	0%
Tall shrub/seedlings (up to 4 1/2 ft, <10% crown closure)	0%	0%
Sapling/pole (4 1/2 ft to 8" dbh)		
10-40% crown closure	3%	0%
40-70% crown closure	0%	0%
>70% crown closure	0%	0%
Mature (8-18" dbh)		
10-40% crown closure	39%*	0%
40-70% crown closure	47%	84%
>70% crown closure	11%	16%
Decadent	0%	0%

*A large percentage of these stands have canopy covers of 30-40%

Bark Beetles

Dendroctonus Sp.

Members of the genus *Dendroctonus* are by far the most destructive group of bark beetles in North America. Twelve species occur in the West (Furniss and Carolin 1977), but only the mountain pine beetle, *Dendroctonus ponderosae*, and the Douglas-fir beetle, *Dendroctonus pseudotsugae*, are likely to have a significant effect on the conifers within the Trout-West analysis area.

Mountain pine beetle (MPB) attacks and kills lodgepole, ponderosa, sugar, and western white pines. Outbreaks frequently develop in dense stands of pole-sized ponderosa pine. When outbreaks are extensive, millions of trees may be killed each year influencing the forest ecosystem (McCambridge et al. 1979). For example, the MPB kills proportionately more large-diameter trees than small-diameter trees and thus alters the diameter distribution (Schmid and Amman 1992).

Silvicultural methods have been found to be the most successful way of preventing major outbreaks. The critical threshold for when outbreaks are likely to occur is between 120-150 square feet of basal area. Maintaining ponderosa pine stands at or below 100 square

feet of basal area is suggested to minimize tree mortality (Schmid and Amman 1992). Willis Schaupp (unpublished, 1999), entomologist for the Rocky Mountain Region, USDA Forest Service, feels that hazardous conditions on the Pike-San Isabel National Forest result when basal areas exceed 120 square feet and recommends thinning to 60-80 square feet of basal area, thus allowing for growth over time.

The Douglas- fir beetle is similar to other *Dendroctonus* bark beetles. Populations can reach epidemic proportions when forests are stressed from overstocking, drought or following outbreaks of Douglas-fir tussock moth. Again, silvicultural methods are the most successful way of preventing major outbreaks (Furniss and Carolin 1997; USDA 2000).

***Dendroctonus* Bark Beetles and Trout-West**

While there are currently no major outbreaks of *Dendroctonus* beetles within the Trout-West analysis area, the vegetation is highly susceptible and *Dendroctonus* bark beetle activity is on the increase throughout Colorado.

Walk-through surveys conducted in the summer and fall of 2001 indicate that nearly the entire Trout-West analysis area (except for some recent plantations and heavy thins) consists of multi-storied stands, which are close to or in excess of 100 square feet of basal area. Thus, virtually the entire analysis area is susceptible to MPB attack. In September of 2002, several pockets of MPB-induced mortality were observed in the Ridgewood and Long John treatment units.

In the summer of 2000, an aerial detection survey was flown to estimate damage and mortality due to insects, diseases, and other forest health stressors in the forests of Colorado. The report (USDA 2001) has shown an annual two-fold or greater increase of MPB-killed trees since 1995. For the year 2000 alone, nearly 275,000 trees were killed, covering over an approximate 140,000 acre area. The single largest area of affected ponderosa pine is in the foothills of the Sawatch Range near Salida, about 50 miles west of Trout-West. The number of dead trees in this area has doubled in just one year. Areas in Douglas and Teller counties (where the Trout-West Project is located) have also been affected.

The report also states that Douglas-fir bark beetle related mortality is still occurring in the lower South Platte River watershed following the major disturbances of the 1993-1995 Douglas-fir tussock moth outbreak.

Douglas-fir Tussock Moth

Douglas-Fir tussock moth (DFTM), *Orgyia pseudotsugata* is member of a group of insects called defoliators, which feed upon tree foliage. The tussock moth is of major importance in the interior Douglas-fir and true fir forests of North America. The tussock moth feeds on Douglas-fir, grand fir, white fir, and subalpine fir and will feed on other conifer species such as ponderosa pine when intermixed with fir. Outbreaks develop explosively and after about 3 years, abruptly subside. Between outbreaks this insect is seldom seen (Wickman et al. 1981; Furniss and Carolin 1977).

DFTM outbreaks like this are sporadic, but when they occur vast areas of Douglas-fir are regularly defoliated, resulting in large-scale mortality. Populations eventually crash, usually as a result of a combination of factors including; starvation, reduced reproductive capacity from a diminish food supply, adverse environmental conditions, and an increase in predation and disease (Wickman et al. 1981).

Studies of large DFTM outbreaks in the Northwestern United States have indicated that the underlying cause of a DFTM outbreak is a susceptible forest. A susceptible forest is characterized by dense, uneven-aged and multi-storied stands of predominately Douglas-fir and/or true firs. Many years of forest management emphasizing fire prevention and suppression, along with other management practices have resulted in a gradual shift from ponderosa pine to Douglas-fir. This change in forest composition and structure has resulted in large areas along the Front Range of Colorado that are more susceptible to large scale DFTM outbreaks (Pike N.F. 1995).

Douglas-fir Tussock Moth and Its Relationship to Trout-West

As discussed in the South Platte Watershed Assessment (USDA 2001), vegetation within the Trout-West Analysis area has changed dramatically as a result of fire suppression. Not only has tree density and canopy cover increased, but also shade tolerant species (particularly Douglas-fir), have expanded their range. Historically, Douglas-fir was restricted primarily to north facing slopes, but now has expanded its range to all slopes aspects except the steepest south facing slopes.

In 1993 a major outbreak of DFTM occurred in the South Platte watershed just north of the Trout-West analysis area. The outbreak defoliated 7000 acres of Douglas-fir scattered over a 19,000 acre area, resulting in significant mortality. This was one of the largest outbreaks of DFTM ever recorded in the State of Colorado and resulted in huge numbers of dead trees (Pike N. F. 1995).

The following table shows the acreage, by treatment unit, of susceptibility to a DFTM outbreak (Table 10). Areas of high susceptibility have dense north facing slopes of Douglas-fir and/or slopes historically dominated by ponderosa pine but now containing a significant component of Douglas-fir. Areas of low susceptibility are stands of pure ponderosa pine or only having only a small component of Douglas-fir.

Table 10. Acreage of Susceptibility to DTMF Outbreak, by Treatment Unit

Treatment Unit	Acres	
	Low Susceptibility	High Susceptibility
Long John	1,289	579
Phantom	1,325	11,642
Rampart	0	1,426
Ridgewood	892	2,568
Ryan Quinlan	1,094	3,108
Skelton	488	912
<i>Total</i>	<i>5,088</i>	<i>20,235</i>

Dwarf Mistletoe

Arceuthobium vaginatum

Introduction

Dwarf Mistletoe, *Arceuthobium vaginatum*, an obligate parasite, is found throughout the Trout-West analysis area. It is particularly prevalent in the Long John, Ryan Quinlan and Ridgewood treatment units. Ponderosa pine is the only conifer species affected by this species of dwarf mistletoe, and *A. vaginatum* is the only species of dwarf mistletoe that was found in Trout-West. The following discussion on dwarf mistletoe biology and control is generic (unless noted) and was adapted (unless noted) from the United States Department of Agriculture Forest Service *Agricultural Handbook 709 – Dwarf Mistletoes: Biology, Pathology and Systematics*.

Arceuthobium is a clearly defined group of small, variously colored flowering plants that are aerial parasites only on members of the Pinaceae and Cupressaceae. They are considered to be the most destructive pathogen of coniferous trees in the western United States.

Dwarf Mistletoe Biology

Dwarf mistletoe plants produce numerous fruits each containing one seed. When the seed is ripe, it is shot out of the fruit at speeds up to 27 miles per hour. Maximum dispersal distance is generally 50 feet, but seed has been found to travel up to 130 feet aided by wind (Scharpf and Parmeter 1971). Most seed, however, falls within 30 feet of the plant. Seeds land on needles and slide down to the branch where they germinate.

From this point it takes the plant 6 years to reach sexual maturity. Seeds are most likely to re-infect the host plant, but can infect a new host if a seed successfully lands on a nearby tree. While this is the most common form of seed dispersal, birds have also been implicated in long distance dispersal of seed.

Dwarf mistletoe seeds are destroyed when ingested by birds, thus birds can only disperse seeds that inadvertently adhere to their feathers and are subsequently deposited where infection is likely to occur. While this method of dispersal is rare, the explosive mechanism of seed dispersal enables dwarf mistletoe to spread rapidly from a newly established center.

Host Reaction

The first external symptom of dwarf mistletoe infection is usually a swelling of the host tissues. As an infection develops, swelling enlarges and eventually becomes fusiform. Typically, dwarf mistletoe infection leads to the production of the profusely branched dense masses of distorted host branches called “witches brooms.”

Dwarf mistletoe infections ultimately reduce a tree’s growth rate in both height and diameter, but only after the upper half of the tree’s crown is parasitized. Growth rate of the host then declines rapidly as the severity of infestation in the upper half of the crown increases. Severe infection will eventually kill the host. The time required for the parasite to kill a tree varies considerably and depends on many factors.

Just how dwarf mistletoes affect the growth and physiology of their host trees is not fully understood. Presumably, they alter the tree’s metabolic balance so that water, minerals, and various assimilates are appropriated by the parasite and infected parts of the lower crown, at the expense of uninfected portions of the crown. An infected branch thus becomes a nutrient sink. Radial growth of infected branches is greatly enhanced, as opposed to uninfected branches in the same whorl. Infected branches also tend to outlive adjacent uninfected branches. As progressively more nutrients are appropriated to infected branches, the vigor of the crown declines, and the tree ultimately dies.

In one study, *A. vaginatum* had significant effects on ponderosa pine, in which average needle length was reduced by 30%, length of needle-bearing stems by 50%, leaf surface by 85%, and number of needles per tree by 80%.

Effect on diameter growth is not measurable until infection severity reaches a dwarf mistletoe rating of 3 (see below for discussion of mistletoe ratings). As infection increases above this threshold, growth rates decline rapidly. Generally, reduction measured as 10-year periodic diameter increment is 10% for DMR class 4 trees, 30% for class 5 trees, and 50% or more for class 6 trees.

In general, effects of dwarf mistletoe on height growth are similar to those of diameter growth, but height reductions are usually slightly greater and are detectable earlier.

Tree mortality rates in *A. vaginatum*-infected stands were found to be higher than in non-infected stands by 1% in DMR Class 1; 4% in DMR Class 2; 8% in DMT Class 3; 15% in DMR Class 4; 23% in DMR Class 5; and 34% in DMR Class 6.

Dwarf Mistletoe Infection Rating System

In the fifties, the Hawksworth 6-class dwarf mistletoe rating (DMR) system was developed. This system works as follows:

1. Divide live crown into thirds.
2. Rate each third separately. Each third should be given a rating of 0, 1 or 2 as described below.
 - (0) No visible infections.
 - (1) Light infection (1/2 or less of total number of branches in the third infected)
 - (2) Heavy infection (more than 1/2 of total number of branches in the third infected).
 - (3) Finally, add ratings of thirds to obtain rating for total tree.

Dwarf Mistletoe and Wildlife

In addition to their role in seed dispersal mentioned above, birds and other wildlife use dwarf mistletoe as a food source and/or as nesting and cover habitat.

The following birds are known to eat the seeds of *A. vaginatum*: Blue grouse, mountain bluebird, western bluebird, evening grosbeak, American robin, and black-headed grosbeak. In a study in central Colorado, the abundance of *A. vaginatum* was found to have a direct correlation with species diversity and bird density. A strong positive correlation was also demonstrated between incidence of dwarf mistletoe and the number of snags used by cavity-nesting birds.

Various mammals utilize dwarf mistletoe shoots as a dietary supplement, but none are dependant on them as a primary food source. Abert's squirrel will remove the shoots and consume the inner bark and associated entophytic system of dwarf mistletoe.

Dwarf Mistletoe and Its Relationship with Fire

(This discussion is derived from *Wildland Fires and Dwarf Mistletoes: A Literature Review of Ecology and Prescribed Burning* [Alexander and Hawksworth 1975])

Wildfires play multiple roles in the distribution of dwarf mistletoe. Fire both encourages and discourages dwarf mistletoe. Relatively complete burns tend to have a sanitizing effect on infested stands, because trees typically reinvade the burned area much faster than the parasite. Partial burns that leave scattered, infected trees or groups of trees throughout the stand may create ideal conditions for rapid spread of dwarf mistletoe.

In addition, several effects of dwarf mistletoe parasitism, such as tree mortality, stunted trees, spike tops, witches' brooms, and resin-infiltrated stem cankers tend to increase the potential fire behavior.

Wildfires have been a primary factor in determining the distribution and intensity of dwarf mistletoes in unmanaged stands. In general, wildfires have tended to keep these widespread parasites in check. Fire exclusion policies in most areas of the West in the last half-century or so, have resulted in increases of both dwarf mistletoe affected area and severity of infection.

Fire exclusion has led to the development of extensive conifer reproduction, and most stands have become two storied, resulting in ideal conditions for maximum spread of dwarf mistletoe. Before fires were controlled in ponderosa pine stands, heat from repeated ground fires, in addition to thinning the understory, pruned back mistletoe-infected branches in the lower crowns, thus limiting the mistletoe plants to a sometimes-inconspicuous presence high in the forest canopy.

Controls

Biological and chemical control of dwarf mistletoe has been attempted, but with little to no success. This has left silvicultural methods as the primary method of controlling dwarf mistletoe infections.

Dwarf mistletoe is an obligate parasite and as a result is totally dependant on its host. Consequently, if the tree or an infected limb dies, the dwarf mistletoe associated with it will die immediately as well. Thinning of mistletoe-infected trees in partially infected stands can be an effective method of control. However, stands that are heavily infected would likely require some form of regeneration harvest, since all or nearly all trees would be infected and have a dwarf mistletoe rating of 4 to 6.

Pruning is also an effective method of controlling dwarf mistletoe. However, it is most effective on trees with DMRs of 3 or less. Trees with DMRs of 4 or greater would require the pruning of virtually all the limbs. This method would still require repeat treatments to pick up latent infections. Limitations to pruning are primarily monetary and are therefore not recommended except within recreation sites.

Dwarf Mistletoe and Its Relation to Trout-West

Dwarf mistletoe, *Arceuthobium vaginatum*, is common throughout the Trout-West analysis area, particularly the Long John, Ridgewood and Ryan Quinlan treatment units. Despite the fact that dwarf mistletoe is a common and native parasite to western conifers, Alexander and Hawksworth (1975) suggest that dwarf mistletoe abundance has increased throughout the Western U.S., as well as the severity of infection. Consequently, the dwarf mistletoe seen throughout Trout-West is likely at historically high levels in terms of abundance and degree of infection.

As discussed above, natural fire has played a major role in dwarf mistletoe distribution and the degree of infection that naturally occurred. Dwarf mistletoe induced brooming has created additional fuels, both aerial and ground, thus contributing to the torching and stand replacement events of the mixed severity fire regime described by Kaufmann and others (Kaufmann et al. 2000; Kaufmann et al. 1999). Trees with DMRs of 5 and 6 were probably not as prevalent as today, since these trees were likely consumed by fire. Likewise, large areas infected by mistletoe weren't as likely since they would have contributed to stand replacement events. These openings, as suggested by Kaufmann (Kaufmann et al. 2000; Kaufmann et al. 1999), could have remained as openings for a period of time or regenerated with mistletoe free trees. Finally, the residual trees would more likely have DMRs of 1 or 2 as fire would prune lower branches, restricting mistletoe to the upper reaches of the crowns. This in turn led to fewer mistletoe plants thus reducing overall seed production. This coupled with low tree density and lower crown ratios due to natural fire pruning likely limited the rate of dwarf mistletoe spread.

Silvicultural recommendations are as follows: target areas having DMRs of 4, 5, and 6 for regeneration; when thinning stands with DMRs of 1, 2, and 3, discriminate against mistletoe-infected trees, but do not seek to eradicate mistletoe. Another option is to create 50 to 100 foot buffers around infected stands when regeneration is not a practical and/or desirable alternative.

The following table list all stands affected by dwarf mistletoe (Table 11).

Table 11. Stands Affected by Dwarf Mistletoe, by Treatment Unit

<u>Project Area</u>	<u>Stand #</u>	<u>Acres</u>	<u>Dwarf Mistletoe Rating</u>
Long John	105	88	4-6
	113	39	4-6
	114	16	4-6
	115	15	4-6
	117	2	4-6
	118	3	4-6
	119	15	4-6
	121	24	4-6
	122	2	4-6
	127	100	4-6
	128	155	0-4
	130	21	0-4
	132	47	0-4
Phantom	247	621	4-6
	252	792	4-6
Ridgewood	402	55	3-6
	403	13	3-6
	406	249	0-6
	411	9	0-6
	414	155	0-6
	420	60	0-6
	421	27	0-6
	427	32	0-6
	444	39	0-6
	449	85	0-6
Ryan Quinlan	501	129	0-4
	505	11	0-3
	508	10	4-6
	509	103	0-3
	511	57	0-6
	515	61	0-6
	516	323	4-6

Environmental Consequences

No Action Alternative

Conifer and Aspen Vegetation

Without Damaging Fire

In this alternative, all treatments would be deferred to some future time, if at all. The forest landscape would continue towards homogeneity and away from the complex, heterogeneous landscape of the historic condition described in Chapter 3 of the EIS. Stand densities and canopy covers would slowly increase, individual tree growth would continue to be suppressed and the development of mature forest characteristics, such as large trees, would be limited. Basal areas are generally over 100 square feet, and canopy covers exceed 30% on 87% of the landscape. Douglas-fir would continue to encroach on ponderosa pine stands. Multiple stand layers would increase as regeneration occurs and/or continues to develop. Aspen would continue to be shaded out and could be lost entirely from the landscape overtime. In summary, the landscape would have no resemblance to the historic condition and if this trend is allowed to continue the entire landscape will be out of the range of variability with regards to the historic condition.

With Damaging Fire

Same as above, plus the following: A 10,500-acre stand replacement fire is expected to burn through the project area in the next 10 years. The burn would be set back the stands to an early seral condition, i.e. grass and forbs. This would be about 40% of the project area, far above the historic condition of 20% for pine and 10% for fir. The disturbance would be more on the order of a landscape level instead of the stand level, creating a homogenous landscape.

If aspen is present, it would likely sprout and could dominate the site for many years. Conifer regeneration, along the burn's perimeter would likely occur within 10-20 years, but regeneration would be sparse to non-existent on the burn's interior form lack of a local seed source. Fire intensity and its damage to soil could further retard conifers from reoccupying the site.

Cumulative Effects

The Polhemus Burn, Trout Creek Timber Sales, and approximately 20 acres of logging on private land increase the acres that are in a condition more like historic; however, the size of these projects are too small to have a significant effect across the watershed, in terms of range of vegetation conditions.

The Hayman fire burned approximately 26,800 acres within the analysis area, setting the majority back to an early seral condition. An additional 4,700 acres is predicted to burn within the analysis area, but outside the project area, within the next 10 years. This would leave approximately 42,000 acres or 30% of the landscape in an early seral

condition. This is well above the historic condition. Aspen is currently sprouting in areas of the Hayman fire and it could become a major landscape component where it existed prior to the burn.

Pathogens

Without Damaging Fire

Dwarf mistletoe infection centers would increase in size and openings would be created due to mistletoe related mortality. If ponderosa pine regeneration occurs in the openings, the mistletoe-infected overstory would likely infect the regeneration.

Susceptibility to mountain pine beetle attack is currently high and will only increase as stand density increases. Mountain pine beetles are currently active throughout the Colorado Front Range, and it is just a matter of time before outbreaks appear in the Trout-West project area. If an outbreak occurs thousands of acres could be affected. The larger diameter, older trees would be attacked first, followed by the smaller trees. Mountain pine beetle related mortality would be significantly reduced tree density and large openings would likely be created. This type of bark beetle activity would not be consistent with historic activity. In the summer of 2002, mountain pine beetle related mortality was observed in the Long John and Ridgewood treatment units.

The likely-hood of a Douglas-fir tussock moth outbreak would increase as Douglas-fir increases in density and continues to encroach onto ponderosa pine sites. An outbreak would likely affect thousands of acres killing Douglas-fir of all sizes and age classes, following a similar pattern to the outbreak north of the project area in the early 1990s. This type of bark beetle activity would not be consistent with historic activity.

All of these effects would increase fuels on the landscape increasing the likelihood of a catastrophic or stand replacement fire.

With Damaging Fire

A 10,500-acre fire in the project area would set the burned stands back to an early seral stage, removing conifer hosts for mistletoe, bark beetles and tussock moths. By removing potential breeding areas for bark beetles and tussock moths, there would be some, but probably minor, beneficial effect to the unburned areas.

The fire would create a barrier to dwarf mistletoe movement, forcing mistletoe to move around the burn area.

Cumulative Effects

Polhemus, Trout Creek and the Hayman fire and the projected 4,700 acres of additional damaging fire will have some minor beneficial effect, but would not significantly slow the spread spread of bark beetles and tussuck moth into the project area. In fact, bark beetles are currently active in the project area.

Dwarf mistletoe is currently found within the project area and Polhemus, Trout Creek, and the Hayman Fire and the additional 4,700 acres of projected fire will have no effect on its spread through the project area. However, the Hayman Fire will form a major barrier to the spread of dwarf mistletoe from the project area until it regenerates with pine.

Old Growth

Without Damaging Fire

Based on Mel Mehl's old growth descriptions and characteristics, there is little to no old growth in the project area primarily due to the minimum age requirement of 200 years. In 50 to 100 years most of the landscape would have the minimum 10 trees per acre, 16 inches (18" for Douglas-fir) diameter at breast height (DBH), and 200 years of age. Most if not all the pine stands would be multi-storied, however, which is not an old growth characteristic for pine. In the absence of treatment, the development of old growth over time would likely be threatened by forest pathogens, i.e. mountain pine beetle, tussock moth and dwarf mistletoe, which could convert large acres of potential old growth to an earlier seral condition.

Old growth identified by the Forest's Wildland Resource Inventory System (WRIS) would remain susceptible to fire and insect outbreaks. It is likely; that some of these old growth or potential old growth stands would lose whatever old growth characteristic they have to fire or insects.

With Damaging Fire

The effects are the same as above, except a stand replacement fire is expected to occur in the project area converting 10,500 acres to an early seral condition.

Cumulative Effects

The Polhemus Burn, Trout Creek Timber Sale, and any understory thins on private land will contribute to the old growth component over time.

The Hayman fire has returned approximately 26,800 acres to an early seral condition. It will take at least 200 years for conifer old growth to return. Another stand replacement fire is predicted to burn in the analysis area, converting an additional 4,700 acres to an early seral stage.

Proposed Action

Conifer Vegetation

Without Damaging Fire

This alternative would treat approximately 20,170 acres (leaving about 6,000 acres untreated). The treated acres (over 75% of the forested landscape) would be thinned to an average canopy cover of 15 to 20%, but could range from 10 to 30% on a stand level. This would largely mimic the historic condition for stands exceeding 10% canopy cover. However, no openings would be created and therefore the 30% of the landscape that historically had less than 10% canopy cover would remain forested. On the treated acres all pine stands would be single storied, and Douglas-fir would be (except for minor amounts) restricted to northerly aspects. Where aspen exists it would be released and become a major stand component. Treated stands would have a variety of densities to increase stand complexity.

In time, canopy covers will increase and natural regeneration would likely occur, aspen would again be overtopped and shaded out by conifer growth. After 20 to 30 years, additional treatments would likely be needed to maintain this condition.

Where fuels are burn, particularly when broadcast burning is used, nutrients would be recycled into the soil and made available for tree and plant use. Site quality would improve on a short-term basis with this flush of nutrients.

There are 950 acres in which slash would be treated on site. This would likely require several entries. Therefore, the beneficial impacts would be incremental until the desired condition is reached at which time the consequences would be the same as other treated acres.

In time, canopy covers will increase and natural regeneration would likely occur, aspen would again be overtopped and shaded out by conifer growth. After 20 years, additional maintenance treatments would likely be needed to maintain this condition. All treated acres would likely increase in density uniformly and if follow-up maintenance treatments don't occur, stands within the project area would simultaneously obtain a level of high susceptibility to stand replacement fire.

With Damaging Wildfire

In addition to the above, a 10,500 acre stand replacement fire is expected to burn through the project area, setting it back to an early seral condition, i.e. grass and forbs. This would be about 40% of the project area, far above the historic condition of 20% for pine and 10% for fir. The early seral condition would be on the order of landscape level instead of the stand, creating a homogenous landscape instead of a heterogeneous landscape. If aspen is present it would likely sprout and could dominate the site for many years. Conifer regeneration along the burn's perimeter would likely occur within the near future (10 to 20 years), but regeneration in the burn's interior would be sparse to non-

existent for many years from lack of a seed source. However, any acres treated prior to a stand replacing wildfire would burn at a low intensity leaving the stand structure intact.

Cumulative Effects

The Polhemus Burn, Trout Creek Timber Sales, and approximately 20 acres of logging on private land increase the acres that are in a condition more like historic; however, the size of those projects is too small to have a significant effect across the watershed, in terms of range of vegetation conditions.

The Hayman fire burned approximately 26,800 acres within the analysis area, setting the majority of the area burned back to an early seral condition. An additional 4,700 acres is predicted to burn within the analysis area, but outside the project area, within the next 10 years. This would leave approximately 42,000 acres or 30% of the landscape in an early seral condition. This is well above the historic condition. Aspen is currently sprouting in the areas of the Hayman fire and it could become a major landscape component where it existed prior to the burn.

Pathogens

Without Damaging Fire

Dwarf Mistletoe infected trees would be heavily thinned, in particular, the higher rated trees (DMRs of 4-6) would be discriminated against. Dwarf mistletoe would not be removed from the landscape, but would likely be set back to a level more closely resembling the historic condition. With a more open, single-layered forest condition, mistletoe spread would be slowed. Since this alternative does not provide for openings, as found in the historic condition, there would still be no natural barriers to mistletoe movement.

Mountain Pine Beetle activity would be reduced to historic levels and the chance of a major outbreak would be unlikely. While some untreated stands would still be susceptible, a major outbreak is unlikely due to the small size and isolation of untreated stands from other susceptible stands.

The effect on Douglas-fir Tussock Moth would be similar to that of the mountain pine beetle.

With Damaging Fire

Same as No Action, except that any areas treated prior to the predicted fire would have the same consequences as above.

Cumulative Effects

Same as No Action.

Old Growth

Without Damaging Fire

Though still needing 50 to 100 years to meet the 200 year age requirement for old growth, treated stands would be in a far better position to attain that than untreated stands. Trees in treated stands would increase in size and the stands should exceed the minimum DBH requirements of 16" and 18" for pine and fir respectively. More importantly is that the stands would not be susceptible to radical stand structure changes from stand replacing fire or major insects outbreaks.

The WRIS identified old growth would be have the same consequences as other stands.

With Damaging Fire

The predicted fire would convert 10,500 acres to an early seral condition; however , any acres treated prior to the fire would retain its current stand structure and ability to move towards old growth.

Cumulative Effects

The Polhemus Burn, and Trout Creek Timber Sale, and any understory thins on private land will contribute to the old growth component over time.

The Haymen fire has returned approximately 26,800 acres to an early seral condition. It will take at least 200 years for conifer old growth to return. An additional 4,700 acres are predicted to burn in the analysis area, converting it as well to an early seral stage, requiring 200 years to reach an old growth condition. However, since the predicted fire could occur anytime within the next 10 years, its damaging effects would be mitigated by any acres treated prior to the fire occurrence.

Alternative A

Without Damaging Fire

This alternative treats 19,220 acres (950 fewer than the Proposed Action). The landscape would be thinned similar to the Proposed Action, but excess fuels would be removed from the site in lieu of burning. Cumulative effects and consequences, including those for old growth and pathogens, would be the same as the Proposed Action, except for 950 acres that would not be treated.

Removing all slash offsite for disposal means that beneficial nutrients, particularly nitrogen, would be removed from the site as well. Not only does the site fail to benefit from the flush of recycled nutrients, but also site quality could be somewhat degraded with the loss of nutrients. If this treatment was repeated every 20 to 30 years, site quality could be seriously degraded.

The additional 950 acres of untreated landscape would have similar consequence to untreated acres in the Proposed Action. This difference in acres treated would not be sufficient to have any additional overall effects on the landscape from mountain pine beetle and Douglas-fir tussock moth.

With Damaging Fire

The consequences are identical to the Proposed Action, including old growth and pathogens.

Cumulative Effects

The effects are identical to the Proposed Action.

Alternative B

Without Damaging Fire

In this alternative, 14,600 acres would be treated. Treated acres would be thinned in a similar fashion as the Proposed Action. The consequences for, including those for pathogens and old growth, treated and non-treated acres would be the same as treated and non-treated acres in the Proposed Action.

The major difference between this alternative and the Proposed Action is the large number of contiguous untreated acres in the Phantom treatment unit. The effects on these treatment units, including the potential for major outbreaks of mountain pine beetle and/or Douglas-fir tussock moth, are almost identical to the No Action alternative. While treatments in the other treatment units (i.e., Long John, Ridgewood, Ryan Quinlan and Skelton) have been reduced only slightly, overall the consequences are almost identical to the Proposed Action.

With Damaging Fire

Impacts would be identical to the Proposed Action; however, since a fire is projected to occur within the next ten years, any acres treated prior to a stand replacing wildfire would likely burn at a low intensity mitigating the harmful effects on those acres.

Cumulative Effects

Same as Proposed Action.

Alternative C

The consequences including cumulative effects would be identical to the Proposed Action.

Alternative D

Without Damaging Fire

This alternative treats 6,750 acres. The consequences on treated acres would differ than other alternatives, however. There would be a diameter cap on all thinned trees and dwarf mistletoe could not be discriminated against when selecting leave trees under a thinning operation. The diameter cap would limit thinning intensity, leaving many stands or portions of stands at higher canopy covers than desired.

Most of the Long John, Ridgewood, Skelton, and about half the Ryan Quinlan treatment units would be treated reducing the potential for large tussock moth and bark beetle infestations. However, the potential for large insect outbreaks would not be reduced to the same extent as the Proposed Action. Canopies would close in at a faster rate than the Proposed Action, requiring a second follow-up treatment sooner than the Proposed Action.

The untreated acres would have similar consequences to untreated acres in the other alternatives. The western half of Ryan Quinlan, all of Rampart, and the majority of the Phantom treatment unit would be slated as no-treatments. The consequences, therefore, would be essentially identical to the No Action alternative, including the potential for large insect outbreaks.

In time, canopy covers will increase and natural regeneration would likely occur, aspen would again be overtopped and shaded out by conifer growth. This would occur sooner than other action alternatives. Additional maintenance treatments would be required sooner to maintain this condition than in other action alternatives. All treated acres would likely increase in density uniformly and if follow-up maintenance treatments don't occur, stands within the project area will simultaneously obtain a level of high susceptibility to stand replacement fire.

With Damaging Fire

Same as the Proposed Action for treated and untreated acres, except that since thinning intensity would not be as great as the Proposed Action. Consequently, the treated stands under this alternative would not have the same resistance to stand replacement fire as other treated stands under the action alternatives.

Cumulative Effects

The Polhemus Burn, Trout Creek Timber Sales, and approximately 20 acres of logging on private land increase the acres that are in a condition more like historic; however, the size of those projects is too small to have a significant effect across the watershed, in terms of range of vegetation conditions.

The Hayman fire burned approximately 26,800 acres within the analysis area, setting the majority back to an early seral condition. An additional 4,700 acres is predicted to burn

within the analysis area, but outside the project area, within the next 10 years. This would leave approximately 42,000 acres or 30% of the landscape in an early seral condition. This is well above the historic condition. Aspen is currently sprouting in the areas of the Hayman fire and it could become a major landscape component where it existed prior to the burn.

Alternative E

Without Damaging Fire

This alternative treats approximately 26,320 acres or about 6,000 more than the Proposed Action. Of the acres treated, 70% of the pine stands and 85% of the Douglas-fir stands would be thinned identically to those in the Proposed Action and would therefore have the same consequences. Openings of 2 to 40 acres in size (averaging 20 acres) would be created on the remaining stands. One third of the openings would be regenerated, while the remaining would be allowed to become long-term or persistent openings. This alternative most closely resembles the historic condition of any alternative.

The consequences for the thinned areas would be identical to treated areas in the Proposed Action.

The openings would add further ecological benefits by providing natural barriers to the movement of dwarf mistletoe across the landscape, and further breaking up the host species for mountain pine beetle and Douglas-fir tussock moth. This alternative would maintain mountain pine beetle and Douglas-fir tussock within the historic range of variation and reduce outbreaks to historic levels.

In 20 to 30 years, as stated in the consequence for the Proposed Action, the canopy would close in again and follow-up treatments would likely be required to maintain the historic condition. In this alternative, only 70% of pine stands and 85% of Douglas-fir stands would require maintenance treatments. The openings would not require treatment and would act as an ecosystem buffer if maintenance treatments of the previously thinned stands had to be delayed.

The persistent openings would convert to grassy openings at low elevations and on southern exposures and become stands of aspen on more northerly aspects and higher elevations further adding to stand complexity.

With Damaging Fire

Same as Proposed Action except as follows: In other action alternatives, it was noted that stands would grow at relatively similar rates and simultaneously reach high canopy densities and susceptibility to stand replacement fire. This is also true for thinned stands in this alternative, however the stands returned to an early seral condition would still have low canopy covers and a higher resistance to stand replacement fire than thinned stands.

Cumulative Effects

Same as Proposed Action.

Old Growth

The effects on old growth would be the same as the treated acres in the Proposed Action, except for the openings. Openings would be located, whenever possible, in younger smaller stands so that pockets of larger trees, including the WRIS old growth stands, would be retained and managed as future old growth. The openings would have their canopies reduce to less than 10%; consequently some trees would be left on site. Again, the largest and oldest trees would be left, so while the openings would not qualify as old growth, a number of large-old individuals would be present.

If selected, this alternative would likely require a Forest Plan Amendment; otherwise the Forest may be out of compliance with the National Forest Management Act and its reforestation requirements.

Cumulative Effects

Same as Proposed Action.

Several tables follow that compare the existing and historic distribution of landscape structures, as well as the effects of each alternative (Tables 12 - 25).

Table 12. Trout-West – Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	<1	<1	<1	<1	<1	<1	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	3	3	3	3	3	3	3
Mature 8-18" DBH								
10-30% CC	25-30	9	72	71	46	72	21	60
30-40% CC	0-5	30	6	6	25	6	33	1
40-70% CC	4	47	8	9	15	8	32	4
>70% CC	1	11	11	11	11	11	11	1
Decadent	15	0	0	0	0	0	0	0

Table 13. Trout-West – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	69	68	48	69	29	80
40-70% CC	4	84	15	16	36	15	55	4
>70% CC	1	16	16	16	16	16	16	1
Decadent	15	0	0	0	0	0	0	0

Table 14. Long John – Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	2	2	2	2	2	2	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	14	14	14	14	14	14	14
Mature 8-18" DBH								
10-30% CC	25-30	20	48	48	48	48	47	51
30-40% CC	0-5	0	0	0	0	0	0	0
40-70% CC	4	43	15	15	15	15	16	4
>70% CC	1	21	21	21	21	21	21	1
Decadent	15	0	0	0	0	0	0	0

Table 15. Long John – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	100	100	100	100	100	80
40-70% CC	4	100	0	0	0	0	0	5
>70% CC	1	0	0	0	0	0	0	0
Decadent	15	0	0	0	0	0	0	0

Table 16. Phantom – Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	0	0	0	0	0	0	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	1	1	1	1	1	1	1
Mature 8-18" DBH								
10-30% CC	25-30	7	70	68	40	70	8	63
30-40% CC	0-5	34	12	12	36	12	38	1
40-70% CC	4	47	6	8	12	6	42	4
>70% CC	1	11	11	11	11	11	11	1
Decadent	15	0	0	0	0	0	0	0

Table 17. Phantom – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	85	84	49	85	17	80
40-70% CC	4	87	2	3	38	2	70	4
>70% CC	1	13	13	13	13	13	13	1
Decadent	15	0	0	0	0	0	0	0

Table 18. Rampart - Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	0	0	0	0	0	0	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-30% CC	25-30	0	55	55	12	55	0	64
30-40% CC	0-5	50	0	0	38	0	50	1
40-70% CC	4	36	31	31	36	31	36	4
>70% CC	1	14	14	14	14	14	14	1
Decadent	15	0	0	0	0	0	0	0

Table 19. Rampart – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	21	13	4	21	0	80
40-70% CC	4	77	56	64	73	56	77	4
>70% CC	1	23	23	23	23	23	23	1
Decadent	15	0	0	0	0	0	0	0

Table 20. Ridgewood - Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	4	4	4	4	4	4	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	1	1	1	1	1	1	1
Mature 8-18" DBH								
10-30% CC	25-30	48	83	83	83	83	71	59
30-40% CC	0-5	0	0	0	0	0	0	0
40-70% CC	4	47	12	12	12	12	24	10
>70% CC	1	0	0	0	0	0	0	0
Decadent	15		0	0	0	0	0	0

Table 21. Ridgewood – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	60	60	60	60	60	56
40-70% CC	4	98	38	38	38	38	38	28
>70% CC	1	2	2	2	2	2	2	1
Decadent	15	0	0	0	0	0	0	0

Table 22. Ryan Quinlan - Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	0	0	0	0	0	0	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	5	5	5	5	5	5	5
Mature 8-18" DBH								
10-30% CC	25-30	0	88	88	72	88	42	59
30-40% CC	0-5	31	0	0	4	0	33	1
40-70% CC	4	57	0	0	12	0	13	4
>70% CC	1	7	7	7	7	7	7	1
Decadent	15	0	0	0	0	0	0	0

Table 23. Ryan Quinlan – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	64	64	60	64	35	80
40-70% CC	4	66	2	2	6	2	31	4
>70% CC	1	34	34	34	34	34	34	1
Decadent	15	0	0	0	0	0	0	0

Table 24. Skelton - Pine Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	20	0	0	0	0	0	0	20
Tall Shrub/Seedling	10	0	0	0	0	0	0	10
Sapling/Pole	20	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-30% CC	25-30	3	81	81	81	81	73	65
30-40% CC	0-5	0	0	0	0	0	0	0
40-70% CC	4	78	0	0	0	0	8	4
>70% CC	1	19	19	19	19	19	19	1
Decadent	15	0	0	0	0	0	0	0

Table 25. Skelton – Fir Stands
Percent of Landscape By Structure Stages

Structure Stage	Historic Condition	No Action	Proposed	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Grass/Forb	10	0	0	0	0	0	0	10
Tall Shrub/Seedling	5	0	0	0	0	0	0	5
Sapling/Pole	30	0	0	0	0	0	0	0
Mature 8-18" DBH								
10-40% CC	35	0	40	40	40	40	31	80
40-70% CC	4	54	14	14	14	14	23	4
>70% CC	1	46	46	46	46	46	46	1
Decadent	15	0	0	0	0	0	0	0